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Boonstra, Bernard; Sterken, Elmer

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# To What Extent Does Human Capital Increase the Home Country Bias?

Bernard Boonstra and Elmer Sterken

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## Abstract

This paper analyses the role of human capital as a hedge against future unexpected changes in consumption of nontradable goods. We show, in line with Baxter-Jermann (1997) that human capital aggravates the home country bias, although we find a lower increase of the bias based on an empirical analysis for the U.S. economy.

## 1 Introduction

The theory of international finance assumes rational international investors to share risk optimally. If they do so and hedge risk across countries, then all resources are used most efficiently. Since the 1970s financial economists pointed out that domestic investors tend to underinvest in foreign securities. This empirical finding is known as the *home country bias puzzle* (see French and Poterba, 1991). Many studies addressed the home bias puzzle since. Although some elements of the puzzle seem to be solved a large fraction of the problem is still not clear (see Lewis, 1999, for a review). In their review of major puzzles in international macroeconomics Obstfeld and Rogoff (2000) therefore label the home bias puzzle as one of their six mysteries.

In this paper we do not pretend to solve the home country bias puzzle. We study a small detail of the puzzle: the role of nontraded wealth, in particular the role of human capital. The role of human capital in solving the puzzle seems not so promising since Baxter and Jermann (1997). At first sight one might be convinced of the fact that, if goods cannot be traded and domestic investors expect to be paid in terms of these goods, they are willing to hold more assets that are linked up with nontradables. This would solve the home bias puzzle to some extent, since domestic investors like to hold domestic equity. Baxter and Jermann (1997) show that domestic human

capital returns are highly correlated with domestic but not with foreign stock market returns. Since human capital is nonmarketable, this finding implies that international investors should hold even more foreign assets. The inclusion of human capital in the model explaining the puzzle thus worsens the magnitude of the problem.

We give alternative estimates of the relevant correlations between returns on human capital and domestic and foreign asset returns. From our results it is clear that human capital indeed worsens the home bias puzzle but to a smaller extent than Baxter and Jermann suggest. In order to present our arguments we first discuss the highlights of the home bias puzzle theory and some empirical estimates of the magnitude of the puzzle in section 2. Next we present a framework to include human capital in full-fledged expected utility optimizing model in section 3. After that we present our empirical estimates and compare them with previous findings in section 4. We conclude in section 5.

## 2 The home country bias: models and estimates

The equity home bias puzzle is most easily understood in mean-variance efficient frontier analysis. As Lewis (1999) shows a 100 per cent US portfolio is dominated by a portfolio with at least 40 per cent foreign equity. As we show below empirical estimates of foreign equity holdings are much lower than 40 per cent. The importance of this finding is large. If investors do not optimally allocate their financial wealth, international risk sharing is suboptimal, and consumption plans cannot be carried out. Indeed, macroeconomic consumption analysis shows that ex post marginal rates of substitution in consumption are unequal across countries, while complete risk sharing would imply equality. So the real consequences of the equity home bias are rather big and therefore the home bias deserves attention.

What are the standard explanations of the equity home bias? The first class of explanations suggests that domestic equities provide a better hedge for risks that are specific to the home country. Lewis (1999) describes three types of these possible sources of risk: inflation, nontraded wealth (such as human capital), and the impact of the multinational character of corporations. If Purchasing Power Parity does not hold in the very short run, international diversification is wanted for. The role of nontraded wealth is discussed below. The fact that stock prices of multinational corporations correlate strongly with domestic market developments do not make this line of thinking promising to explain the puzzle either. The second class of ex-

planations of the puzzle look at a cost-benefit analysis of diversification. If the costs exceed the gains, there would be a limit to diversifying the portfolios. Lewis concludes that this is unlikely, since new information and trade systems make trade cheaper through time. Obstfeld and Rogoff (2000) think that trading costs are important and probably an explanation of the home bias though. Finally, Lewis (1999) asks some attention for the third class of explanations of the puzzle: the impact of uncertainty in returns on the diversification strategy. If returns are uncertain the hypothesis that portfolios with foreign investments are not better performers than domestic portfolios alone cannot be rejected. This would imply that an analysis of the timing of investment is relevant. In line with this it is of course interesting to analyze flows instead of stocks.

We do not give a general analysis of the equity home bias but focus on the analysis of the role of human capital. Human capital is a large component of nontraded wealth (for the US about 60 per cent, if this share can be approximated by the labor's share in total income). If nontraded wealth is important, human capital would be the number one component to consider. Baxter and Jermann (1997) show that the returns on human capital correlate with returns on domestic assets for Japan, Germany, the U.K. and the U.S.. There is a lower correlation with foreign returns on capital. This implies that individuals who want to hold a diversified portfolio need a short and not a long position in domestic marketable assets. Baxter and Jermann (1997) proxy the returns on human capital by a bi-variate time-series analysis of labor and capital income assuming stationarity of the labor share of income in the long run. In this paper we simply include the wage rate as a measure of return on human capital. This has a stronger appeal to the idea that earned wages indicate the productivity of human capital. Moreover, as we show this approximation leads to a lower correlation between human capital and domestic returns, with resulting consequences for the equity home bias. A related study is Bottazzi, Pesenti and Van Wincoop (1996). They investigate the impact of fluctuations in the return to human capital on the composition of international asset portfolios and adopt a continuous-time VAR model of international portfolio choice which allows for intertemporal interactions between wage rates and capital returns. Applying the model to a large set of OECD countries, their findings account for an average bias of about 30 percentage points toward domestic securities.

How big is the home bias? Without pretending to give a complete survey we illustrate the findings up to now. For the U.S. normally a huge bias towards domestic assets is found. Tesar and Werner (1998) illustrate that the U.S. home bias seems to decline by the mid-1990s though. For example

French and Poterba (1991) find that in 1989 the U.S. investor allocated 94 per cent of his equity portfolio to domestic equity. Cooper and Kaplanis (1991) conclude that in 1987 the average American investor has allocated 98 per cent of his total equity investment into domestic assets. Investors in Japan, the United Kingdom and Germany are not performing differently by allocating respectively 86.7, 78.5, and 75.4 per cent into domestic equities. Bohn and Tesar (1996) report a home equity bias for the U.S. of 92 per cent. For bond holdings the home bias is smaller but not small enough to neglect (Obstfeld and Rogoff, 1996). German and Swiss data examined by Gehrig (1993) confirm the stronger bias in equity holdings indeed. For 1987 Gehrig finds that German funds hold only 20 per cent of their total equity holdings in foreign equity, - the proportion of foreign bonds of their total bond holdings is about 30 per cent. Examining the portfolio composition of Swiss banks in 1985, it is shown that 36 per cent of the equity portfolio consists of foreign equity and only 45 per cent of the bond portfolio is foreign. Tesar and Werner (1995) find for 1988 similar results by investigating life insurance companies and pension funds. For example, Japanese and American pension funds hold only 7 and 4 per cent of their total portfolio in foreign assets.

### 3 The model

In this section we illustrate the equity home bias in the Pesenti-Van Wincoop (1996) model (PW model). We discuss our amendment of human capital in detail. The PW model is a rational expectations representative agent model that allows for nontraded goods. The representative consumer maximizes expected utility over an infinite horizon. Utility is a function of the consumption of both traded  $C$  and nontraded goods  $X$ . The consumer faces the following optimization problem:

$$\max E_t \left[ \int_t^\infty \exp(-\gamma(s-t)) U(C(s), X(s)) ds \right] \quad (1)$$

where  $\gamma$  represents the discount factor and  $0 \leq t \leq s$ . The utility function has the usual properties plus the characteristic of complementarity of tradables and nontradables  $U_{CX} > 0$ . The complementarity assumption has a strong implication: the consumer only makes a choice for one of the variables. The domestic industry produces nontradable goods such that the supply is given by the following geometric Brownian motion:

$$\frac{dX(t)}{X(t)} = \mu dt + \sigma_X d\xi(t) \quad (2)$$

with  $\xi(t)$  normal Brownian motion, and  $\mu$  and  $\sigma_X$  parameters.  $\xi(t)$  is assumed to be standard Brownian motion.<sup>1</sup>

The consumer can save and accumulate wealth  $Q(t)$ :

$$dQ(t) = [n(t)dR(t) + (1 - n(t))dR^*(t)]W(t) + L(t)dw(t) - C(t)dt - E(t)dt \quad (3)$$

This expression implies that wealth increases by investing  $n(t)$  at home with a cumulative return  $R(t)$ , and  $(1 - n(t))$  in a foreign asset with a return  $R^*(t)$ , by a return  $w(t)$  on human capital  $L(t)$ , and decreases by consumption  $C(t)$  and education expenditure  $E(t)$ . We added the return on human capital and the education expenditure to the PW-specification. The consumer problem is so to determine optimal consumption, education expenses and the portfolio plan. PW assume instantaneously stochastic returns on domestic and foreign equities;

$$dR(t) = \eta dt + \sigma_R d\omega(t) \quad (4)$$

$$dR^*(t) = \eta dt + \sigma_{R^*} d\omega^*(t) \quad (5)$$

with  $\eta$  the common expected return and the  $\omega$ 's the standard Brownian motion processes. Furthermore PW assume the following correlations:  $\rho = (d\omega d\omega^*)/dt$ ,  $\rho_{RX} = (d\omega d\xi)/dt$ , and  $\rho_{R^*X} = (d\omega^* d\xi)/dt$ .

Since we include human capital and its return, we need to specify their stochastics. We describe the availability of human capital by the geometric Brownian motion:

$$dL(t) = E(t)dt + \sigma_L L(t)dB(t) \quad (6)$$

where  $\sigma_L$  represents the volatility and  $B(t)$  a standard Brownian motion. Human capital can be increased via education expenditure  $E(t)$ . The returns on human capital,  $w(t)$  are assumed to be stochastic:

$$dw(t) = \alpha dt + \sigma_w d\phi(t) \quad (7)$$

where  $\alpha$  is the drift rate,  $\sigma_w$  the volatility, and  $\phi(t)$  a standard Brownian motion. Furthermore we assume that the return on human capital correlates with the financial assets:  $\rho_{Rw} = (d\omega d\phi)/dt$ , and  $\rho_{R^*w} = (d\omega^* d\phi)/dt$ .

The optimization problem now is the maximization of (1) with respect to the choice of the paths of  $C$ ,  $n$ , and  $E$  given conditions (2), (3), (4), (5), (6), and (7). The problem is solved by using the Bellman equation. It

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<sup>1</sup>A standard Brownian motion is represented by  $\epsilon_t \sqrt{dt}$ .

breaks a whole sequence into two components: the immediate decision and a value function  $V$  that encapsulates the future. The general structure of the continuous time Bellman equation is:

$$\delta V = \max U + \frac{E_t[dV]}{dt} \quad (8)$$

On the left-hand side we have the normal return that the holder of an asset worth  $V$  will require. The first term on the right-hand side is the immediate pay-out, while the second term is the capital gain. The Bellman equation can be seen as a no-arbitrage condition. In this case we have two state variables  $X$  and  $Q$ . So the Bellman equation has the following form:

$$\delta V[X(t), Q(t)] = \max_{C, E, n} U(C(t), X(t)) + E_t [dV[X(t), Q(t)]] / dt \quad (9)$$

The problem of solving the Bellman equation is the problem of describing  $E_t[dV]/dt$ . So we expand  $dV$  using Itô's Lemma. For the home bias we are interested in  $n$ . The result is similar in structure to PW:

$$n = \frac{\sigma_{R^*}^2 - \rho \sigma_R \sigma_{R^*}}{\sigma_R^2 + \sigma_{R^*}^2 - 2\rho \sigma_R \sigma_{R^*}} + bias \quad (10)$$

The first part of this result is a standard mean-variance portfolio solution. The second part is the interesting bias. The bias is defined by, using  $H = -\frac{V_{QX}X}{V_{QQ}Q}$ :

$$bias = H \frac{\sigma_X}{\sigma_R} \left( \frac{\rho_{RX} \sigma_R - \rho_{R^*X} \sigma_{R^*}}{\sigma_R + \sigma_{R^*}^2 \sigma_R^{-1} - 2\rho \sigma_{R^*}} \right) - \frac{L}{Q-L} \frac{\sigma_w}{\sigma_R} \left( \frac{\rho_{Rw} \sigma_R - \rho_{R^*w} \sigma_{R^*}}{\sigma_R + \sigma_{R^*}^2 \sigma_R^{-1} - 2\rho \sigma_{R^*}} \right) \quad (11)$$

where  $Q - L$  represents financial wealth. The first component of this bias is equal to the one found by PW. Our extension is represented by the second term. What is the economic interpretation of this bias? The bias is formed as a result of hedging the risk of future consumption of nontradables. Both domestic and foreign assets can be used for hedging. The consumer must be able to finance tradables whatever the consumption of nontradables is. If domestic asset returns correlate positively with nontradable consumption domestic assets will deliver the required returns. So the bias depends on  $\rho_{RX}$ . Furthermore the scope for hedging increases if the variance of nontradable consumption increases. PW also show that the propensity to hedge  $H$  depends on the complementarity of tradables and nontradables  $U_{CX}$ .

What's now the role of human capital? One important result to notice is the Baxter-Jermann (1997) finding. The bias is reduced if the correlation between return on human capital and domestic assets ( $\rho_{Rw}$ ) is large and between human capital and foreign assets ( $\rho_{R^*w}$ ) is small or negative. We will illustrate this with U.S. data in the next section.

## 4 Empirical estimates

Next we will use the definition of the bias given before in the model with human capital for U.S. data. The annual data on nontradables consumption are from the OECD National Accounts. These annual data are available at current prices. We have defined nontradables consumption as the sum of gross rent, fuel and power; medical care and health expenses; recreational, entertainment, education and cultural services; personal care; expenditures in restaurants, cafes, hotels; transport and communication minus personal transport equipment. The annual returns on domestic assets ( $dR$ ) are determined as follows:

$$dR = \theta dR_{STOCK} + (1 - \theta)r \quad (12)$$

where  $dR_{STOCK}$  is the annual return on stock by MSCI monthly data. The risk-free rate  $r$  is assumed to be equal to the end of period FED discount rate (taken from the *International Financial Statistics*).  $\theta$  is the ratio of stock market capitalization to total financial claims. The total financial claims are assumed to equal the sum of stock market value, long term government debt and M2. Data on long term government debt and M2 come from the *International Financial Statistics* and the U.S. stock market value data come from the *Statistical Abstract of the U.S.*. The return on foreign assets ( $dR^*$ ) is determined in a similar way. However, we have made some assumptions. First of all we assume that  $\theta^*$  is equal to  $\theta$  in each year. Furthermore we assume that the risk-free rate  $r^*$  is two basis points below the U.S. rate  $r$ . We have selected a group of 12 countries that represents the rest of the world<sup>2</sup>. For each country, we determine the annual return on stock by using the MSCI monthly data. These annual returns are then weighted by 1985 GDP per adult in order to find an approximation for the return on foreign stock. We use GDP per adult inhabitant instead of GDP per capita because GDP per adult is a better measure for productivity. Further we need data on human capital. We were able to find wage-rate adjustments for U.S.

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<sup>2</sup>These countries are Canada, Japan, Germany, France, Italy, U.K., Australia, The Netherlands, Belgium, Denmark, Norway, and Sweden.



industries. The data are from the *Statistical Abstract of the U.S.*. This data tells us how the returns on human capital develop over time and enables us to estimate the volatility of wages.

Next we discuss the estimation of the volatility parameters  $\sigma_R$ ,  $\sigma_{R^*}$ , and  $\sigma_L$ . Assume that the sample  $\{\Delta R_t : t = 1, \dots, n\}$ ,  $\{\Delta R_t^* : t = 1, \dots, n\}$ , and  $\{\Delta \omega_t = 1, \dots, n\}$  are drawn from the processes (4), (5) and (7). It is known that  $\Delta R_t$  and  $\Delta R_{t+s}$  are *i.i.d.* variables for all  $t$  and  $s$ . The same is true for  $\Delta R_t^*$  and  $\Delta \omega_t$ . We apply OLS to find estimates for  $\alpha$  and  $\eta$  and the volatility parameters. For example, the residuals  $\{e_t^R : t = 1, \dots, n\}$  give the estimator:

$$\sigma_R^2 = \frac{\sum_{t=1}^n (e_t^R)^2}{n} \quad (13)$$

For the geometric Brownian motion  $X$  we follow Björk (1998). Let  $\psi_t = \log X_t/X_{t-1}$ . The variance  $\sigma_X^2$  can be estimated by:

$$\hat{\sigma}_X^2 = \frac{\sum_{t=1}^n (\psi_t - \bar{\psi})^2}{n - 1} \quad (14)$$

where  $\bar{\psi}$  is the mean of  $\psi$ . Finally we estimate the parameters  $\rho$ ,  $\rho_{RX}$ ,  $\rho_{R^*X}$ ,  $\rho_{Rw}$ , and  $\rho_{R^*w}$  by taking the observed correlation between the samples considered. The sample period starts in 1970 and ends in 1996.

As PW we assume a CES-utility function and use their estimate of the propensity to hedge  $H=0.7$ .<sup>3</sup> A last assumption we made is with respect to the ratio of human capital to financial wealth  $L/(Q-L)$  which we take to be 0.5. Table 1 gives the main results. The upper panel shows our estimates for two periods: 1970-1996 and 1983-1996. The lower panel the outcomes.  $MV$  stands for the mean-variance result,  $n$  for the implied domestic portfolio share,  $B$  for the bias,  $BX$  for the bias due to the hedging of nontradables and  $BL$  for the hedging due to human capital.

The first thing to notice in Table 1 are the estimates of  $\rho_{Rw}$  and  $\rho_{R^*w}$ . Our estimates do suggest a positive correlation between human capital and domestic assets, but much smaller than Baxter-Jermann find. On the other hand we find even a negative correlation of the return on human capital and

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<sup>3</sup>This estimate is based on the CES utility:

$$U(C, X) = \frac{1}{1-\eta} \left[ \alpha X^{1-1/\epsilon} + (1-\alpha) C^{1-1/\epsilon} \right]^{\frac{\epsilon(1-\eta)}{\epsilon-1}} \quad (15)$$

For constructing the propensity to hedge it is necessary to estimate the parameters  $\eta$  and  $\epsilon$ . See Pesenti and Van Wincoop (1996).

Table 1: Home bias and human capital

	1970-1996	1983-1996
$\rho$	0.6450	0.4927
$\sigma_R$	0.0688	0.0522
$\sigma_{R^*}$	0.0807	0.0802
$\sigma_X$	0.0263	0.0192
$\rho_{RX}$	0.2488	0.0792
$\rho_{R^*X}$	-0.0391	-0.3365
$\sigma_w$	0.0467	0.0195
$\rho_{Rw}$	0.3110	0.0825
$\rho_{R^*w}$	0.1368	-0.3182
$MV$	0.7174	0.8679
$n$	0.7496	0.8933
$B$	0.0322	0.0254
$BX$	0.0915	0.0831
$BL$	-0.0593	-0.0577

foreign assets, while Baxter-Jermann find small positive correlations. As a result we do find a bias, although smaller than Baxter-Jermann. And indeed the role of human capital aggravates the problem (look at the negative values of  $BL$ ). Our findings seem to be more reasonable than the Baxter-Jermann results in this respect. One can see that in our model the mean variance solution explains a large proportion of  $n$ . This is mainly due to the high volatility of foreign assets and the positive correlation between domestic and foreign asset returns.

## 5 Summary and conclusions

We analyze the role of human capital in the equity home bias model. We derive an explicit solution for the home bias using the Pesenti-Van Wincoop (1996) model. It is shown that human capital, being an important component of nontraded wealth, plays an important role in the equity home bias puzzle. If the return on human capital is positively correlated with the yield on domestic assets human capital will lower the bias, as Baxter and Jermann (1997) showed, and therefore increase the problem of explaining the bias.

We illustrate our model with some stylized facts for the U.S. economy and indeed find that introducing human capital does lead to more problems in explaining the bias, but not to the extent Baxter and Jermann suggest.

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